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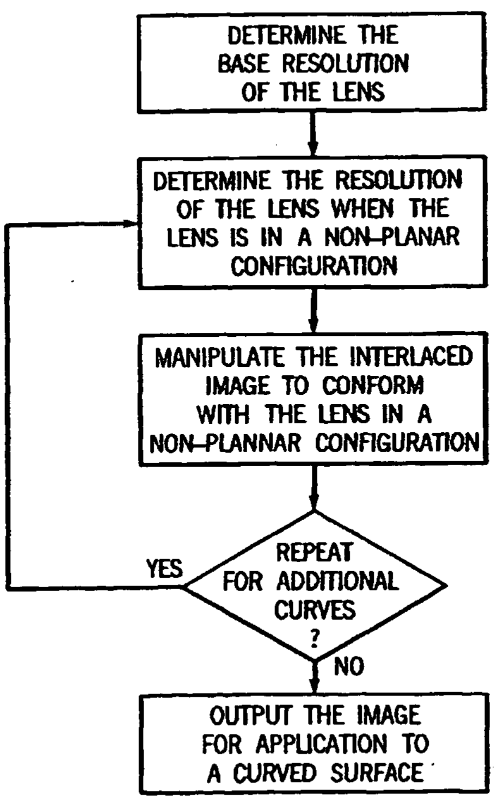
(54) Title: MULTIDIMENSIONAL IMAGING ON A CURVED SURFACE USING LENTICULAR LENSES



(57) Abstract: Methods were disclosed for preparing and applying an interlaced image to a curved surface. In one embodiment of the invention, a method for preparing an interlaced image for application to a curved surface, the interlaced image comprising two or more frames, such that when the interlaced image was viewed through a lenticular lens, the lens comprising a plurality of lenticules and having a base resolution, from a predetermined viewing distance, the interlaced image was viewed substantially free of distortion, the method comprising the steps of: A) determining the base resolution of the lens; B) Determining a resolution of the lens when the lens was configured to conform to the curved surface; C) manipulating the interlaced image, the image comprising interlaced segments, to conform with the resolution of the lens as applied to the curved surface such that the lenticules of the lens were in correspondence with the segments of the image; and D) outputting the interlaced image for application to the curved surface.

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MULTIDIMENSIONAL IMAGING ON A CURVED SURFACE USING LENTICULAR LENSES

The present invention relates generally to multidimensional imaging using lenticular lenses, and more particularly to a method for manipulating a planar multidimensional image so that when viewed through a lenticular lens the image can be viewed on a curved surface with little, if any, distortion.

Successful sales of a product depend not only on the quality of the product itself, but also on the uniqueness of the advertising for the product. Advertising takes many forms and spans many media, but often, the best advertising is on the product itself or on its packaging. To improve sales, bright color schemes and glitzy decor were often utilized to call potential customers' attention to the product. Recently, lenticular lens technology, which allows for multidimensional imaging on a two-dimensional, or planar, surface has come into increasing use in product and point-of-purchase displays.

Lenticular lenses are well-known and commercially available. Methods for using lenticular lens technology were described in detail in U.S. Patents 5,113,213; 5,266,995; 5,488,451; 5,617,178; 5,847,808; and 5,896,230.

Lenticular technology is already in use on a variety of items, such as: promotional buttons, magnets, coasters, collectibles, display posters, signs, menu boards, packaging on boxes, postcards and business cards. Lenticular technology is also in use on point-of-sale materials such as product labels. These applications have a common characteristic in that the lenticular technology has been applied generally to planar or flat surfaces.

Indeed, the results when attempting to apply lenticular technology to curved surface have been less than desirable. Those skilled in the art have found that when attempting to apply lenticular technology to such curved applications, the viewer, when viewing at a predetermined viewing distance, experiences distortion. This distortion might take any of a number of forms, for example, from seeing different images at different viewing angles (that is, banding), to experiencing blurring or bleeding of the image. If these problems were solved, the underlying image would appear to the viewer as one continuous band, rather than the viewer experiencing multiple, broken, or banded images. U.S. Patent 5,642,226 to Rosenthal describes a lenticular optical system in which image lines were compressed so that a curved image changes as a whole.

Rosenthal discloses a drawing of an image on a curved, that is, cylindrical, surface. Rosenthal teaches aligning each image line under a corresponding lenticule. Aligning the image lines equally under the lenticules creates a narrow viewing band that follows the viewer as the cylinder was turned or if the cylinder was stationary, as the viewer moves around the cylinder. Rosenthal, however, fails to describe the significant difference in optical properties of a simple curved surface and a cylindrical surface. For example, proper imaging to a curved geometric surface requires manipulating the interlaced image based on multiple variables. The variables were dependent on the curved surface. Additionally, each variable was dependent upon the shape of the surface to which the image will be applied.

What was needed, therefore, was a method for applying lenticular technology to curved surfaces so that the viewer, when viewing the multidimensional image, experiences little, if any, image distortion. To this end, a method was required for manipulating an image so that when it was applied to a curved, for example, a frustoconical, surface and viewed through a lenticular lens, the image was substantially free of distortion. Therefore, the desired three-dimensional effect was achieved for the viewer when viewing the image at the appropriate viewing distance.

In one embodiment, the present invention provides a method for applying multidimensional imaging using lenticular lenses to a curved surface, for example, a frustoconical or parabolic surface, such as the type found in various packaging, point-of-purchase displays and other forms of advertising. The invention allows a viewer to see the image from a predetermined distance without experiencing significant image distortion. The method was predictable and reproducible, and thus it decreases the variance from project to project and this, in turn, decreases production costs.

These benefits were achieved by a method for preparing an interlaced image for application to a curved surface, the interlaced image comprising two or more frames, such that when the interlaced image was viewed through a lenticular lens, the lens comprising a plurality of lenticules and having a base resolution, from a predetermined viewing distance, the interlaced image was viewed substantially free of distortion, the method comprising the steps of:

A. Determining the base resolution of the lens;

B. Determining a resolution of the lens when the lens was configured to conform to the curved surface;

C. Manipulating the interlaced image, the image comprising interlaced segments, to conform with the resolution of the lens as applied to the curved surface such that the lenticules of the lens were in correspondence with the segments of the image; and

D. Outputting the interlaced image for application to the curved surface.

In another embodiment of the present invention, a substantially flat, composite blank was provided for the construction of an article having at least one curved surface, the composite blank comprising:

A. a substrate having first and second opposing surfaces;

B. an interlaced image; and

C. a lenticular lens sized and shaped to overlay the substrate, the lens comprising a plurality of lenticules, the lens having

(i) a first flat surface, and

(ii) a second opposing surface comprising lenticules,

with the proviso that the image was carried on the first flat surface and that the lenticules of the lens were in correspondence with the interlaced image such that the image can be viewed through the lenticular lens by a viewer at a predetermined viewing distance from the image with minimal, if any, distortion.

In still another embodiment of the present invention, a method was provided for making a substantially flat, composite blank for the construction of an article comprising at least one curved surface, the method comprising the steps of:

A. printing an interlaced image to one of a lenticular lens and a substrate such that the image was in correspondence with the lens;

B. cutting the lenticular lens to a shape corresponding to the shape of the article projected in a planar configuration;

C. applying an adhesive to at least one of the substrate and the lenticular lens;

D. applying the cut lenticular lens to the substrate to form a composite blank precursor; and

E. cutting the composite blank precursor to a shape corresponding to the article projected in a planar configuration to create the composite blank.

In another embodiment, a substantially flat lenticular blank for configuration into a curved surface was provided, the lenticular blank comprising:

A. an interlaced image;

B. a lenticular lens comprising a plurality of lenticules, the lens having

(i) a first flat surface, and

(ii) a second opposing surface comprising lenticules, and

C. a coating layer;

wherein the image was carried on the first flat surface such that the lenticules of the lens correspond with the interlaced image so that the image can be viewed through the lenticular lens by a viewer at a predetermined viewing distance from the image with minimal, if any, distortion when the image was configured into the curved surface.

In yet another embodiment, a method was provided for making a substantially flat lenticular blank for configuration into a curved surface, the method comprising the steps of:

A. affixing an interlaced image to a lenticular lens such that the image was in correspondence with the lens;

B. applying a coating layer to the image; and

C. cutting the lenticular lens to a shape corresponding to the curved surface projected in a planar configuration.

And in another embodiment, a method was provided for making a substantially flat, composite blank for the construction of an article comprising at least one curved surface, the blank comprising at least one lip to facilitate the construction of the article, the method comprising the steps of:

A. printing an interlaced image to one of a lenticular lens and a substrate such that the image was in correspondence with the lens;

B. applying an adhesive to at least one of the substrate and the lenticular lens;

C. mounting the lenticular lens to the substrate;

D. cutting a portion of the lenticular lens;

E. cutting the substrate along a desired perimeter to form the composite blank; and

F. removing a portion of the lenticular lens.

Various other features, objects and advantages of the present invention will be made apparent from the following detailed description and the drawings.

FIG. 1 was a flowchart describing one embodiment of a method for preparing an interlaced image for application to a curved surface.

FIG. 2 was an illustration of a resfinder useful in determining the resolution of a lenticular lens.

FIGS. 3 and 4 illustrate the concept of correspondence between an image and a lenticular lens for a viewer when viewing at long and short viewing distances, respectively.

FIG. 5 was an illustration of a frustoconical curved application for multidimensional imaging.

FIG. 6 was an illustration of the application of multidimensional imaging to a frustoconical curved surface.

FIG. 7 was a top view of a blank for a frustoconical sidewall of a container, the blank comprising a lenticular lens layer and supporting layer.

FIG. 8 is a view of the blank taken along section 8-8 of FIG. 7.

FIG. 9 is a top view of an arrangement of multiple blanks on a single sheet for large production runs.

FIG. 10 is a view taken along section 10-10 of one of the blanks from FIG. 9.

FIG. 11 is a top view of a blank and supporting material from FIG. 9 for a frustoconical sidewall of a container, the blank comprising a lamination of a lenticular lens and a supporting layer, the view displaying removal of a portion during production thereof.

FIG. 12 is a view that was taken along section 12-12 of the blank from FIG. 11.

FIG. 13 is an illustration of imaging that was prepared in accordance with the present invention prior to its application to a curved surface.

FIG. 14 is an illustration of the prepared imaging from FIG. 13 as applied to a curved surface and viewed from a first position, the imaging being properly viewed on the curved surface.

FIG. 15 illustrates the imaging from FIG. 14 when viewed from a second position.

FIG. 16 is an illustration of imaging that was not prepared in accordance with the

present invention prior to its application to a curved surface.

FIG. 17 is an illustration of the imaging from FIG. 16 being applied to a curved surface and viewed from a first position, and further illustrating that the imaging, not having been prepared in accordance with the present invention, was not properly viewed, and does not appropriately fit, on the curved surface.

FIG. 18 illustrates the imaging from FIG. 17 when viewed from a second position.

The present invention provides a method of applying interlaced images to a curved surface such that there was little, if any, distortion from a predetermined viewing distance. The images themselves were preferably of photographic quality, and provide the viewer with the illusion of motion and/or depth.

Referring to FIG. 1, preferably, the base resolution of the lens was determined by any conventional technique. "Resolution" in this context means the number of lenticules per linear inch. Even if the resolution was known from the manufacturer of the lens, often an independent confirmation of the resolution was desirable because it was a factor in constructing and manipulating the interlaced, composite image. Furthermore, manufacturing always introduces a variance to one extent or another, and thus, it was desirable to determine the base resolution.

One method of determining the base resolution of the lens was through the use of a resfinder, one embodiment of which was shown in FIG. 2. Resfinders were particularly useful in determining the base resolution of lenses that were the subject of high volume production runs. As depicted in FIG. 2, a resfinder was preferably a series of identical interlaced segments A, B, C, etc., of an image, each interlaced segment comprising a series of columns or rows (shown in FIG. 2 as columns) a, b, c, etc. which were segments of a series or set of frames. Typically, one such column of each interlaced segment was black and the remaining columns were white. (As depicted in FIG. 2, the black columns were "dashed"). The position of the black column of each interlaced segment was the same, for example, the black column was the "a" column of each interlaced segment. The columns within an interlaced segment were typically of equal width, and typically the number of columns were the same from interlaced segment to interlaced segment. Resfinder patterns, such as that shown in FIG. 2, of the appropriate resolution can be created through the use of various commercially available software programs such as

Adobe™ Photoshopã, manufactured by Adobe Systems Inc. of San Jose, CA.

The resfinder, or a set of resfinders, of known resolution was/were created and outputted. Typically the output was a negative film imaged on a contract proof. One such proof was 3M's Matchprint™, by Imation™.

The resfinder, specifically its interlaced pattern, was then manipulated or aligned with the lenticules of the lenticular lens to achieve a one-to-one correspondence. This alignment was made when the lenticular lens was in a planar configuration. As here used, "planar" means flat. If all of the segments of the resfinder were aligned with the lenticules of the lens, then one-to-one correspondence was achieved and the resolution of the lens was determined (or confirmed) since the resolution of the lens was the same as the resolution of the resfinder (which was known from its construction). If correspondence was not acquired, that is, one or more interlaced segments was not in alignment with a corresponding lenticule, then a new resfinder was prepared and this step of alignment repeated until correspondence was acquired. Using the example of FIG. 2, the appearance of a solid black image (described in greater detail below) through the lens was indicative that correspondence has been acquired. "Correspondence" means that each interlaced segment of the resfinder was covered by one lenticule and that the lenticule and interlaced segment were substantially congruent with one another.

In order to create an image that will provide a viewer with a multidimensional effect (including, perhaps, an illusion of motion), first an interlaced image must be created. The interlaced image was an image formed from two or more base or component images. Typically, twelve pictures were interlaced with one another in any desired sequence to form the interlaced image or picture that was then viewed through a lenticular lens. The lenticular lens in conjunction with the interlaced image provides the illusion of depth and/or motion to the viewer.

For proper interlacing, the component images were in digital form, or pixels, so that they can be manipulated electronically. Illustrative images include photographs, graphics, typeface, logos, animation, video, computer-generated or digital art, vignettes, tints, dimensional art, graphs, charts and similar information. If these images were conventional print or art, then they were first converted into electronic data using, for

example, optical scanning methods. Alternatively, the images were created electronically by some other conventional means, for example, commercially available art software.

For those interlaced images from which an illusion of motion was desired, the component images were sequenced in an order that imparts an illusion of motion. For example, if an image of a child swinging was desired, then two or more pictures of the child taken at different points in the swing path were acquired and sequenced in a manner that accurately describes the swing path.

Once all of the information that was to be included in the interlaced image was in electronic or pixel form, a series of digital frames was created. Such frames will make up the interlaced image. Each digital frame was a unique image, and two or more images were used. Each digital frame could itself be comprised of more than one component image or element. Such digital frames were composite frames. These composite frames were used to create an interlaced, composite image. Each digital frame may be created to impart motion and/or a multidimensional effect as desired.

Digital frames were typically created using Adobe™ Photoshop™. The digital frames may then be sequenced or interlaced by any convenient method, for example, the methods described in U.S. Patents 5,488,451 and 5,896,230, referenced earlier.

Typically a segment of each frame was in the form of a rectangular column and the height and width of each such column was the same. These frames will then make up interlaced segments. The width of a segment typically mimics the width of the lenticule with which it will eventually be aligned so the viewer perceives a one-to-one correspondence. However, in reality, the curved surface to which the image and lenticular lens were applied requires that the image must be larger than the corresponding lenticular, that is, it "grows." The number of frames can vary to convenience, and typically the more frames per image, the better the illusion of motion and/or depth.

Once the interlaced image was formed, it was then aligned with the lenticular lens such that the segments of the composite image were "in resolution", or correspondence with the lenticules of the lens. Such "correspondence" means that each segment of the interlaced image was covered by one lenticule and that the lenticule and segment were substantially congruent with one another.

Correspondence was easily confirmed by viewing the interlaced image through the lenticular lens at a predetermined viewing distance. If the image was without distortion and imparts the desired depth and/or motion effect, then correspondence was acquired. If it was not, then process continues in an iterative manner until correspondence was acquired.

If correspondence was to be maintained, the segments of the interlaced image become coarser as the viewing distance decreases. In other words, the interlaced segments widen since the resolution of the interlaced image must maintain correspondence with the image through the lens from a given viewing distance. FIG. 3 was a representation of correspondence between lens 28 and image 40 (specifically the image segments, that is, A, B, C . . .) for viewer 2 at a long (for example 12-20 ft.) viewing distance. FIG. 4 is a representation of correspondence for viewer 4 at a short (for example arm's length) viewing distance. FIGS. 3 and 4 also show second viewers 4 and 8, respectively, representing someone who was not viewing the image from a proper viewing distance. Such a viewer falls out of correspondence, and would therefore perceive distortion of the image.

Referring again to FIG. 1, and having determined the base resolution, the next step in applying an interlaced image to a curved surface comprises determining a second resolution of the lenticular lens. In this instance, the lens was configured to conform to a curved surface. In a preferred embodiment, this step was accomplished again using of one or more resfinders.

For example, when the curved surface was a cylinder, the lens was configured to the cylinder and one or more resfinders was or were applied until correspondence was achieved. If the curved surface was a cylinder of varying diameter, for example, frustoconical, then this measuring procedure may be repeated at different diameters over the length of the cylinder. The quality of the interlaced image as viewed through the lenticular lens at a predetermined distance will depend, at least in part, on the number of such measurements.

Once a sufficient number of resolutions have been determined, then the interlaced image was manipulated in any convenient manner to orient the image to the resolutions of the lens in its ultimate non-planner configured state. Depending on the complexity of the

surface, this process may need to be repeated. One convenient method for manipulating the image, and specifically the frames of the image, was to use a commercial "warping" software to warp or adjust the image. One such software was Avid Technologies' ELASTIC REALITY™. This software was used to warp the image to compensate for the distortion that will occur in a curved application. There were also other image-warping (also known as image-mapping or distortion) programs that were commercially available. More specifically, the method involves mapping the frames of the image such that the image was warped or bent to achieve correspondence with the multiple resolutions of the lens as ultimately configured to the curved surface.

Another option was to manually adjust the interlaced image differently at different points along the surface. Current commercial technology also permits delaying image manipulation until the point of output, in which case an image file was sent to raster imaging processing (RIP) programs, for example, Scriptworks®, manufactured and sold by Harlequin. The RIP can then interpret the image at various resolutions or scale factors, thus allowing the interlaced image to be created once and re-used.

After orienting the interlaced image with the lenticular lens in its ultimate configuration, (which again might require several iterations) the image was outputted at a resolution corresponding to its electronic resolution, and at a size that corresponds to the lenticular lens which will eventually overlay it. The interlaced image can be outputted to a film separation, a set of printing plates, a digital proof, or through a high resolution outputting (that is, digital printing) device, for example, an inkjet printer, a digital press, an electrostatic printer, or a laser printer.

If sent to a digital printing device, the interlaced image may then be either directly or indirectly (that is, the image was printed to a substrate independently of the lens) printed to the lenticular lens. Otherwise, the interlaced image was preferably sent to an imagesetter or platesetter, both high resolution outputting devices. In the case of an imagesetter, a film separation may be made, and from the separation, a proof or plate may then be created. The proof could then be laminated to the lenticular lens, again such that the image and lens were in correspondence. Alternatively, a plate could be created, and the plate utilized to print, either directly or indirectly (again, using a substrate) to the lenticular lens such that the image and lens were in correspondence. A platesetter could

be used instead of an imagesetter to create the plate such that the interlaced image could be printed, again either directly or to the lenticular lens. Here again, the interlaced image and lens would be in correspondence. Preferably, when using a platesetter, a direct digital proof would be created to verify the image integrity (that is, quality, color, content, etc.). The separation may then be used to create the print to which the lenticular lens can be laminated by any conventional technique.

Using an indirect printing method in which the interlaced image was printed to a substrate, the image can be placed in sufficient contact with the lenticular lens so that the position of the image can be altered or adjusted with respect to the lens (for example, a non-permanent display), or the image itself interchanged. This was done in a manner such that correspondence between the image and lens was maintained.

Lenticular lenses typically were made from an array of identical spherically-curved surfaces embossed or otherwise formed on the front surface of a plastic sheet. Each individual lens or lenticule was a section of a long cylinder which typically extends the full length of the underlying image to which it was laminated. The back surface of the lens was typically flat.

The lenticular lens was selected to accommodate the image and viewing distance. For a large application, such as the side of a blimp, marquis, or a vending machine facade, a thick, coarse lenticular lens was usually preferred. For smaller applications, for example, a cup, a fine lenticular lens was preferred. Again, coarse lenticular lenses have fewer lenticules per linear inch than fine lenticular lens. Other factors often considered in the choice of a lenticular lens include the thickness, flexibility, the viewer's viewing distance, and of course, cost of the lens, or method of printing (sheet-fed, lithographic, web, flexography, screen-print, etc.).

Although the construction of an image for application to a curved surface can be described in terms of frames and segments, the image can also be described in terms of frames and rows or other groups of pixels if particular effects were desired. Further, if an electronic or digital base image was prepared, it can be prepared as a grid, and any segment of that grid can serve as a building block for the frame, as previously described.

The geometry (or shape) of the surface to which the image and lenticular lens will be applied or conformed was a factor in the practice of this invention. The surface may be

convex (for example, the external surface of a cup, blimp, etc.), or concave (for example, inside surface of a package, a room, etc.), or both (for example, a sinusoidal surface). The surface may be uniform (for example, a cylinder or sphere), or nonuniform (for example, the face of a mannequin).

Obtaining correspondence using the resfinder involves viewing the interlaced image through the lenticular lens from the predetermined viewing distance over a predetermined viewing band. The viewing band was an area of the image upon which the viewer focuses at any one time, and it could be smaller than the area of the entire curved surface (see FIG. 18, discussed below). Referring again to the resfinder of FIG. 2. The black (dashed in FIG. 2) frames should be "on" across the entire width of the predetermined viewing band. In other words, the 12f (twelve "frames") black and white resfinder described above, when placed up against the lenticular lens, would show only a continuous black appearance across the entire viewing band.

As shown in FIGS. 5 and 6, a project, such as a tall, frustoconical cup 10, may require the use of multiple viewing bands or areas, each having a different resolution. In such instances, preferably multiple resfinders were used to determine the appropriate resolution for each viewing band. In other words, multiple resfinders were used to determine multiple resolutions.

Referring to FIGS. 7 and 8, another embodiment of the invention was shown. In this embodiment, a substantially flat composite blank 20 was used to construct an article such as sidewall 12 of frustoconical cup 10 (FIG. 5). Other articles could be constructed. For example, if designed to accommodate a cylinder, the blank's shape would be rectangular (as shown later in FIG. 16). Blank 20 includes substrate layer 22 (shown in FIG. 8) such as paper stock and has a shape or perimeter defined by inwardly tapered left and right edges 24 and 25, respectively, which extend between curved top and bottom edges 26 and 27, respectively. The substrate could be selected from a variety of other materials including: paper, plastic, glass , wood, or metal. The paper itself could be a synthetic paper. A composite substrate could also be used, and in such instances one or more of the previously mentioned materials could be combined, for instance, using an adhesive. A lenticular lens layer 28 could then be mounted thereon.

FIG. 6 illustrates lenticular blank 30 for configuration into a curved surface. Such a blank could be produced by eliminating, for instance, substrate layer 22. As such, lenticular blanks would necessitate only one cut, that was, to cut the lenticular. Such lenticular blanks could be configured into a sleeve to be wrapped around a curved surface, such as an appropriately sized and shaped cup. For such configurations, the blank could have a shape corresponding to the curved surface projected in a planar configuration, such as a rectangle if a cylindrical article were to be produced. The blank could be designed to cover substantially the entire surface of such an article, or a portion thereof (as shown in FIGS. 14 and 15), depending on project goals and specifications. Such a portion was often referred to as a "belly-band". Further, such a blank could be applied to the curved surface by utilizing commercially available labeling equipment. In this way, the interlaced images could appear on a curved surface and provide the viewer with the illusion of motion and/or depth in a manner substantially free of distortion.

FIG. 8, referenced earlier, shows a cross-sectional view of composite blank 20 having substrate layer 22. FIG. 8 more clearly indicates the multi-layered construction of such a blank. As a practical matter, below and adjacent to the flat back side 28a of lenticular lens layer 28 was image layer 40 (preferably comprising the interlaced image described earlier). Coating layer 42 may be inserted between image layer 40 and an adhesive layer 44 for joining the layers into a composite. In other words, in those instances in which the image was printed or otherwise affixed to flat side 28a of the lens, the image was often coated with any suitable material, for example, a vinyl plastic, or an opaque, white ink. This coating (that is, "floodcoating", or "spotcoating") enhances, or provides contrast for, the image. It may also be used to provide a special effect, such as a glow-in-the-dark effect. Lip 50 comprises substrate layer 22, and was shown in FIGS. 7 and 8. Again, in some instances, more than one lip might be required, and in other instances, such a lip might not be required at all.

Using the construction of cup 10 as an example, an interlaced image was printed or otherwise affixed to the flat side of a lenticular lens (in appropriate correspondence, of course). If desired, the surface of the image opposite the surface adjoining the lens was covered with an appropriate coating as described above. The lens was then cut (that is,

die cut) to the desired configuration (here, the frustoconical shape projected in a planar configuration, as shown in FIGS. 7, 9 and 11 (described further below).

Separately, appropriate paper stock was prepared by coating a surface with an appropriate adhesive. Subsequently, the cut lens was applied to the adhesive-containing surface of the paper stock in such as manner that the lens was essentially permanently affixed to the stock to form a blank precursor. Of course, the lens was applied to the stock such that its image-carrying surface (or alternatively, its coating surface) joins the adhesive-carrying surface of the stock to form a blank precursor.

As shown in FIG. 9, if the paper stock and the lenticular printed sheet were of sufficient size, multiple blanks (for example, 20a and 20b) may be "nested" as shown, or otherwise arranged, to conserve space. In this manner, more than one blank may be formed simultaneously, and thus, mass production was promoted. While FIG. 9 has been referred as a printed sheet, it should be understood that the illustration could represent other printing methods (as described earlier). For instance, FIG. 9 could be an impression area of a web-form.

Once the lens (and image and coating, if any) was permanently affixed to the paper stock, the blank precursor was cut (for example, die-cut) to produce composite blank 20 for forming into the shape of the article desired. Blank 20 was cut such that lip 50 of paper stock was created. Again, in an alternative embodiment, the blank may include two or more lips, or even none at all if the lenticular lens layer was sufficiently thin to permit the formation of the final product without any such lips. The lip(s), if any, assist in the formation of bottom rim 51 and top rim 52 of cup 10 (as shown in FIG. 5). The lip(s) may also facilitate attachment of edges 24 and 25 along sideseam 53 of cup 10 (also FIG. 5).

In another embodiment, blank 20 for the construction of an article having at least one curved surface, and as shown in FIGS. 10, 11, and 12 be produced by mounting lenticular lens layer 28, image layer 40, and coating layer 42 to substrate 22. A spot adhesive process could be applied to either the lens layer, substrate layer, or both, so that area comprising lip 50 of the blank could remain substantially free of adhesive layer 44. This was illustrated in FIGS. 10 and 12 as a gap between adhesive layer portions 44a and 44b. Absence of adhesive was also shown in FIG. 11 using dashed lines.

Referring to FIGS. 11 and 12, in this embodiment, preferably a "kiss" die cut could be performed so as to cut a lenticular lens portion 52, along with an image layer 40 and coating layer 42, if any, overlaying the area of lip 50. This could be performed while permitting the substrate 22 to remain uncut. Lenticular portion 52, remaining substantially free of any adhesive, along with any image and coating layer, could then be easily removed as shown in FIGS. 11 and 12. The lenticular layer and substrate could then be die-cut along any desired perimeter (such as that defined by edges 24, 25, 26, and 27) so as to form blank 20. It should be clear that the cuts referred to above (that is, the "kiss" die cut and the die cut along the perimeter of the blank) could happen in one operation.

FIGS. 13, 14 and 15 show basic imaging (that is, numbers, letters, and a shape), applied to the curved frustoconical surface. More specifically, FIG. 13 illustrates a typical lenticular blank comprising imaging, the blank suitable for making a sleeve to be applied to a cup (more specifically, a "belly-band" since here the sleeve, once wrapped, does not extend over the entire exterior surface of the cup). Utilizing the imaging techniques of the present invention, FIGS. 13-15 illustrate that the images –as applied to the curved surface - appear with little, if any, distortion.

FIGS. 16, 17 and 18 illustrate a blank similar to that of FIGS. 13-15 except that the blank was now rectangular. As noted earlier, such a blank would be useful for application to the surface of a cylinder. However, as one may readily see, such a blank does not properly fit around a more complex shape, that is, a frustoconical. Therefore, the geometry of the blank itself (or the shape of the curved surface projected in a planar configuration) must be adjusted to account for the more complex shape of the article.

More significant with regard to the present invention, one may note that in FIGS. 17 and 18 the imaging appears distorted to the viewer because it has not been prepared in accordance with the present invention for application to the curved surface. For example, the circle from FIG. 17 appears as an oval in FIG. 18. Of course, these were only basic images (line art) and were used by way of example only. Elements that make up the images (i.e, graphics, video, etc.) of the kind envisioned for use in accordance with the present invention were significantly more complex. The method of preparing multidimensional imaging, for instance an interlaced image, for application to a curved

surface of the kind described in detail above was especially suitable and preferable for these more complex elements.

The present invention has been described in terms of preferred embodiments, and it was recognized that equivalents, alternatives, and modifications, aside from those expressly stated, were possible and within the scope of the appending claims.

What was claimed is:

1. A method for preparing an interlaced image for application to a curved surface, the interlaced image comprising two or more frames, such that when the interlaced image was viewed through a lenticular lens, the lens comprising a plurality of lenticules and having a base resolution, from a predetermined viewing distance, the interlaced image was viewed substantially free of distortion, the method comprising the steps of:

A. Determining the base resolution of the lens;

B. Determining a resolution of the lens when the lens was configured to conform to the curved surface;

C. Manipulating the interlaced image, the image comprising interlaced segments, to conform with the resolution of the lens as applied to the curved surface such that the lenticules of the lens were in correspondence with the segments of the image; and

D. Outputting the interlaced image for application to the curved surface.

2. The method of claim 1 wherein the method further comprises the step of mapping at least one of the frames.

3. The method of claim 1 wherein the interlaced image was an interlaced, composite image comprising a plurality of frames, and wherein at least one of the frames was a composite frame, the composite frame comprising a plurality of elements.

4. The method of claim 1 wherein the step of determining the base resolution comprises the steps of:

A. creating a resfinder; and

B. manipulating the resfinder so that the resfinder and the lenticular lens were in correspondence.

5. The method of claim 4 wherein the resfinder comprises a series of interlaced segments of an image.

6. The method of claim 5 wherein the segments comprise frames.

7. The method of claim 6 wherein the segments of the resfinder were aligned with the lenticules of the lenticular lens to achieve correspondence.

8. The method of claim 1 wherein the step of outputting the interlaced images comprises outputting the interlaced image to a high-resolution outputting device.

9. The method of claim 8 wherein the high resolution outputting device was one of: an inkjet printer, a digital press, an electrostatic printer, a laser printer, an image setter, and a platesetter.

10. A curved surface comprising an interlaced image made by the method of claim 1.

11. The method of claim 1 further comprising the step of applying the interlaced image to the curved surface.

12. A substantially flat, composite blank for the construction of an article having at least one curved surface, the composite blank comprising:

A. a substrate having first and second opposing surfaces;

B. an interlaced image; and

C. a lenticular lens sized and shaped to overlay the substrate, the lens comprising a plurality of lenticules, the lens having

(i) a first flat surface, and

(ii) a second opposing surface comprising lenticules,

such that the image was carried on the first flat surface and that the lenticules of the lens were in correspondence with the interlaced image such that the image can be viewed through the lenticular lens by a viewer at a predetermined viewing distance from the image with distortion.

13. The composite blank of claim 12 wherein the layer of substrate comprises at least one of: paper, plastic, glass, wood, and metal.

14. The composite blank of claim 12 wherein the blank comprises an adhesive layer for joining the lenticular lens to the substrate.

15. The composite blank of claim 12 wherein the blank comprises a coating layer.

16. The composite blank of claim 12 wherein the blank includes at least one curved edge.

17. A method for making a substantially flat, composite blank for the construction of an article comprising at least one curved surface, the method comprising the steps of:

A. printing an interlaced image to one of a lenticular lens and a substrate such that the image was in correspondence with the lens;

B. cutting the lenticular lens to a shape corresponding to the shape of the article projected in a planar configuration;

C. applying an adhesive to at least one of the substrate and the lenticular lens;

D. applying the cut lenticular lens to a shape corresponding to the shape of the article projected in a planar configuration;

E. cutting the composite blank precursor to a shape corresponding to the article projected in a planar configuration to create the composite blank.

18. The method of claim 17 wherein the interlaced image comprises segments, the segments aligned with the lenticules of the lenticular lens so as to achieve correspondence.

19. The method of claim 17 wherein the lenticular lens was sized and shaped to overlay the substrate such that the composite blank comprises at least one lip designed to facilitate construction of the article.

20. The method of claim 17 wherein the shape of the article projected in a planar configuration was substantially rectangular.

21. The method of claim 20 wherein the article was substantially cylindrical.

22. A substantially flat lenticular blank for configuration into a curved surface, the lenticular blank comprising:

A. an interlaced image;

B. a lenticular lens comprising a plurality of lenticules, the lens having

(i) a first flat surface, and

(ii) a second opposing surface comprising lenticules, and

C. a coating layer;

wherein the image was carried on the first flat surface such that the lenticules of the lens correspond with the interlaced image so that the image can be viewed through the

lenticular lens by a viewer at a predetermined viewing distance from the image with minimal, if any, distortion when the image was configured into the curved surface.

23. The substantially flat lenticular blank of claim 22, the blank having a shape that was substantially rectangular.

24. A method for making a substantially flat lenticular blank for configuration into a curved surface, the method comprising the steps of:

A. affixing an interlaced image to a lenticular lens such that the image was in correspondence with the lens;

B. applying a coating layer to the image; and

C. cutting the lenticular lens to a shape corresponding to the curved surface projected in a planar configuration.

25. The method of claim 24 wherein the interlaced image comprises segments which were aligned with lenticules of the lens to achieve correspondence.

26. A method for making a substantially flat, composite blank for construction of an article comprising at least one curved surface, the method comprising the steps of:

A. printing an interlaced image to one of a lenticular lens and a substrate such that the image was in correspondence with the lens;

B. applying an adhesive to at least one of the substrate and the lenticular lens;

C. mounting the lenticular lens to the substrate;

D. cutting a portion of the lenticular lens;

E. cutting the substrate along a desired perimeter to form the composite blank; and

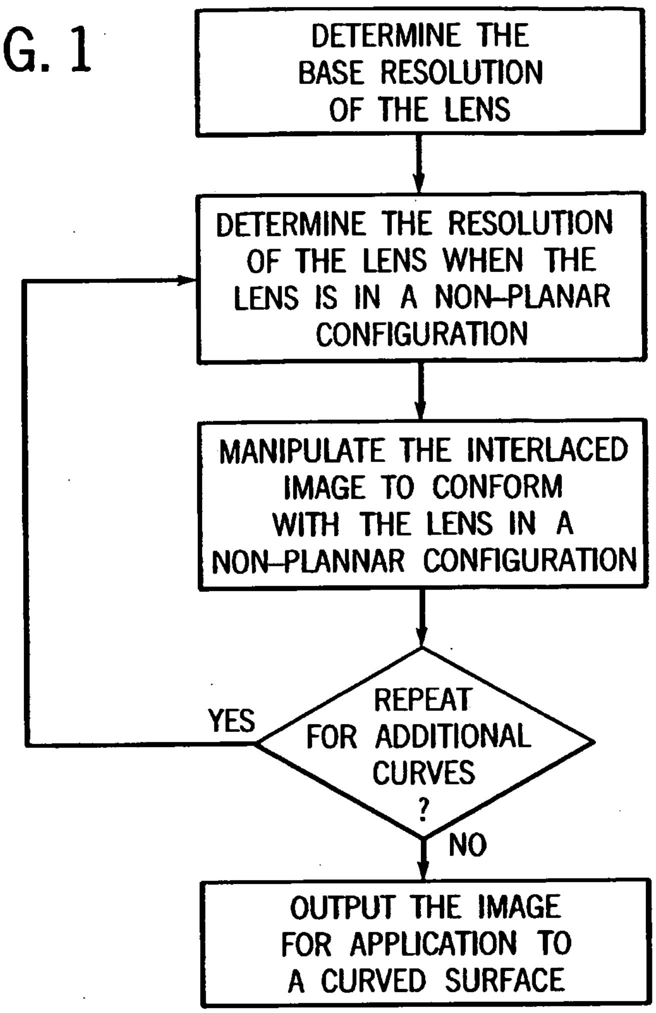
F. removing a portion of the lenticular lens.

27. The method of claim 26 wherein the blank comprises at least one lip to facilitate the construction of the article.

28. The method of claim 27 wherein the step of applying an adhesive was further defined as applying the adhesive so that the portion of the lenticular lens overlaying the at least one lip remains substantially free of any adhesive.

29. The method of claim 28 wherein the step of cutting a portion of the lenticular lens was further defined as cutting the portion of the lens which overlays the at least one lip.

FIG. 1


DETERMINE THE BASE RESOLUTION OF THE LENS
DETERMINE THE RESOLUTION OF THE LENS WHEN THE LENS IS IN A NON-PLANAR CONFIGURATION
MANIPULATE THE INTERLACED IMAGE TO CONFORM WITH THE LENS IN A NON-PLANNAR CONFIGURATION
REPEAT FOR ADDITIONAL CURVES ?
YES
NO
OUTPUT THE IMAGE FOR APPLICATION TO A CURVED SURFACE

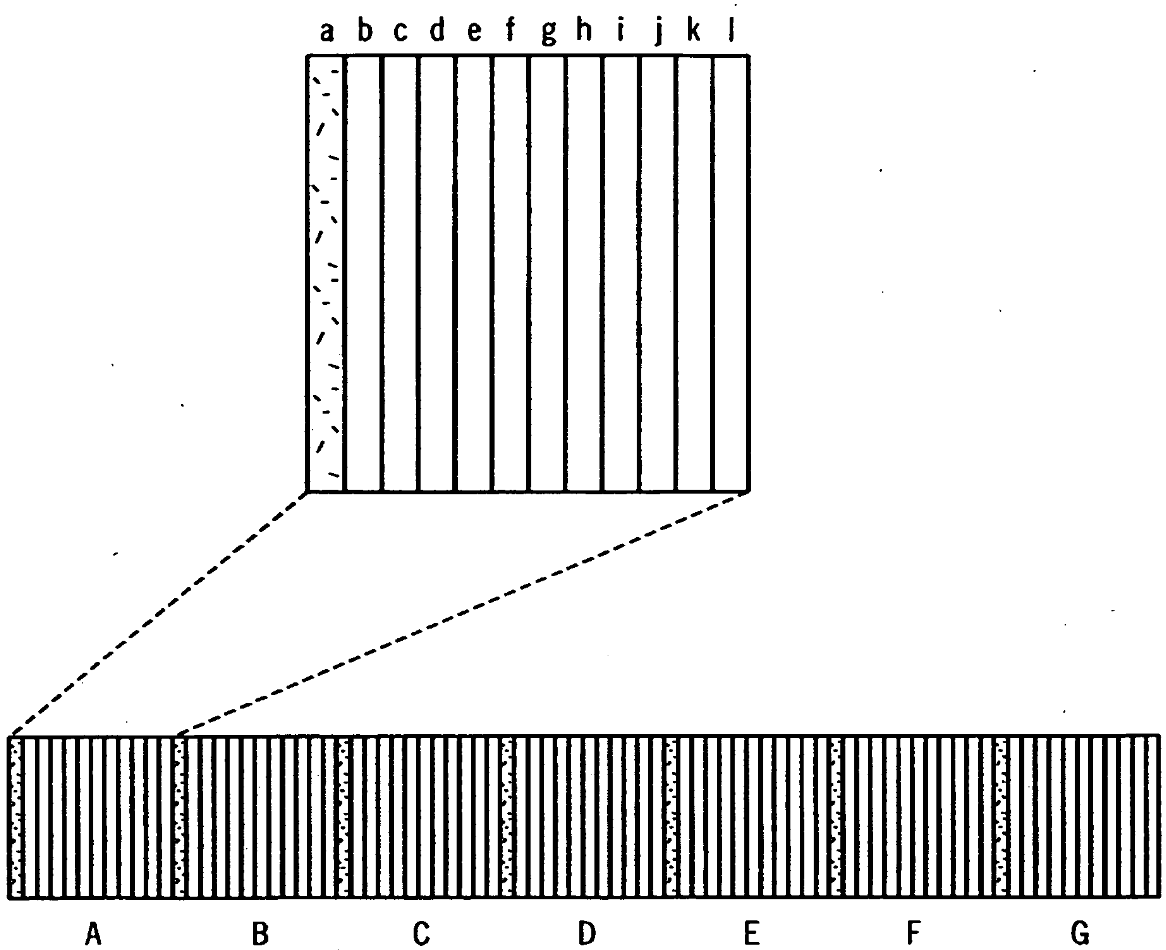


FIG. 2

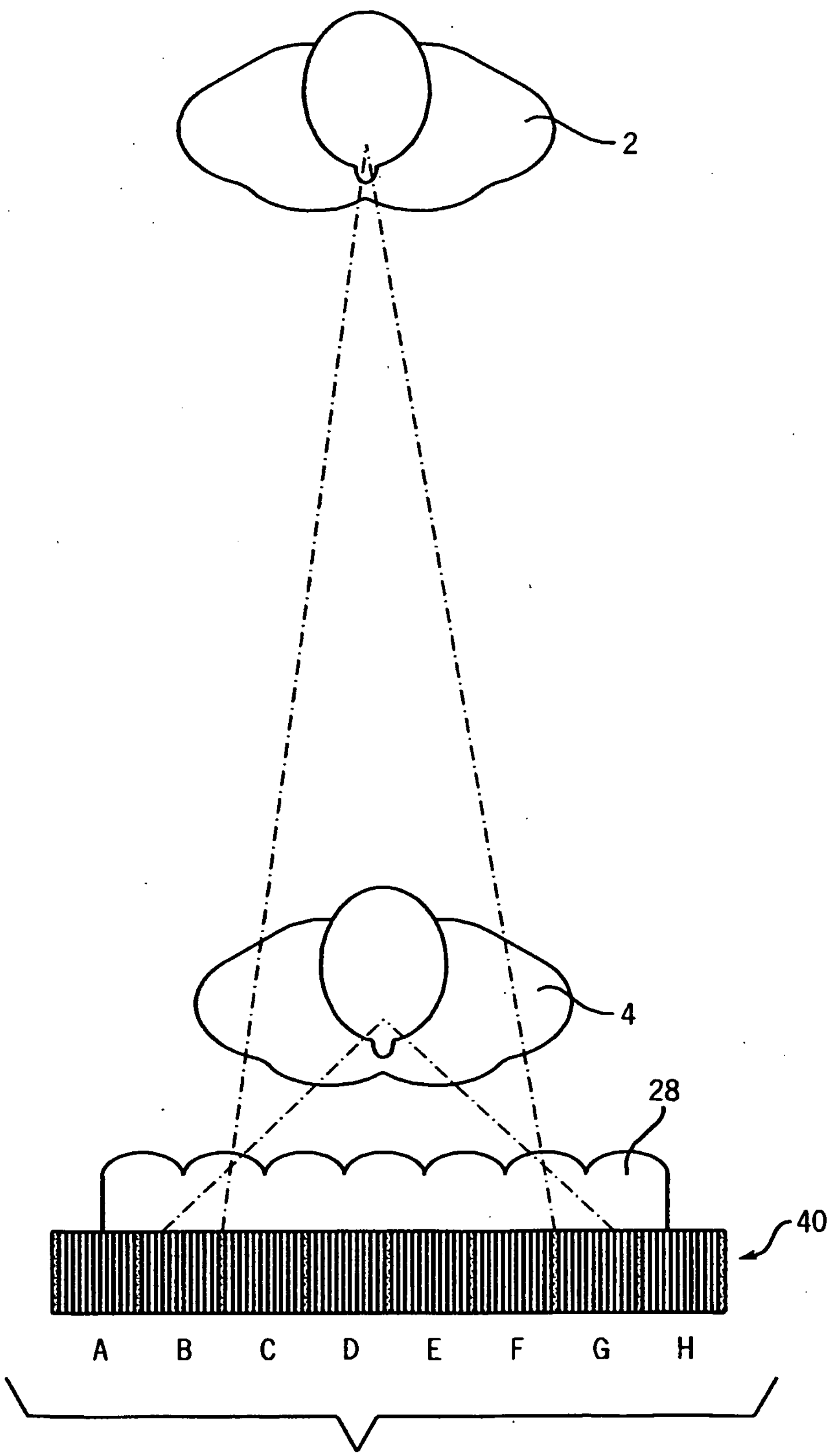


FIG. 3

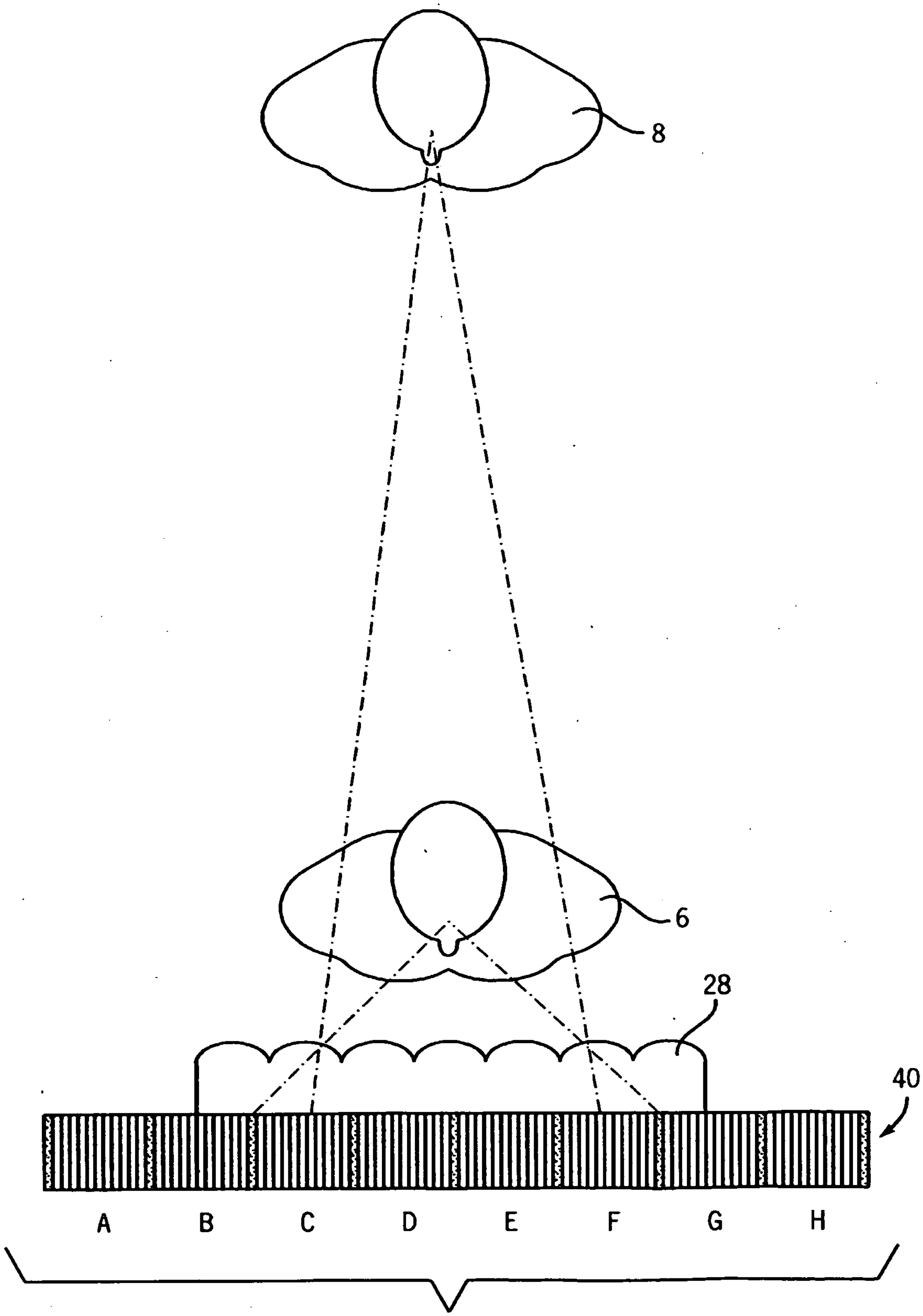


FIG. 4

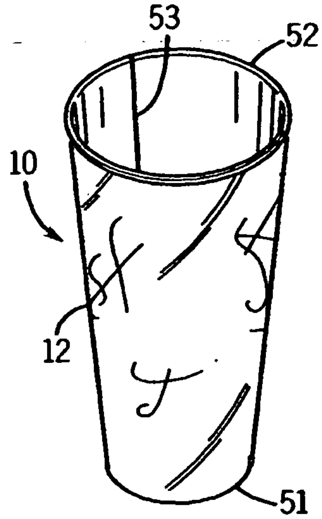


FIG. 5

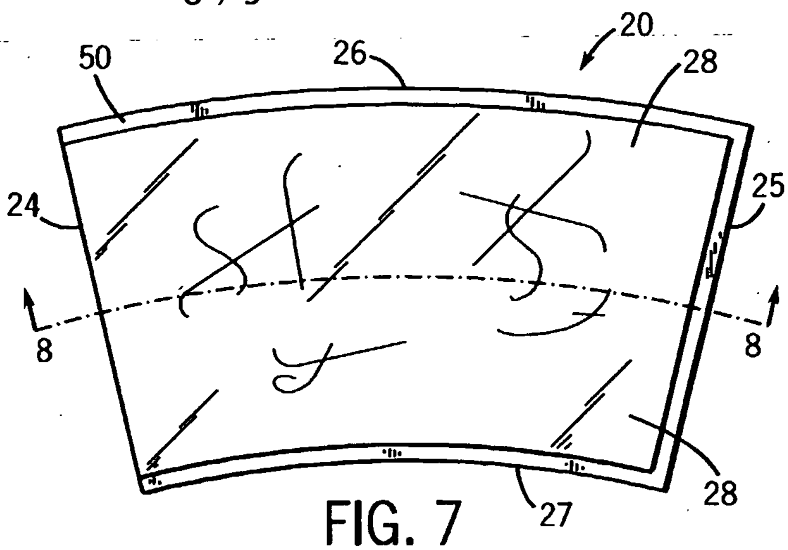


FIG. 7

FIG. 6

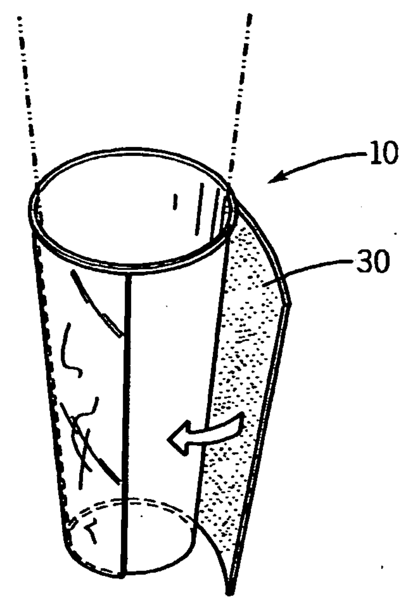


FIG. 8

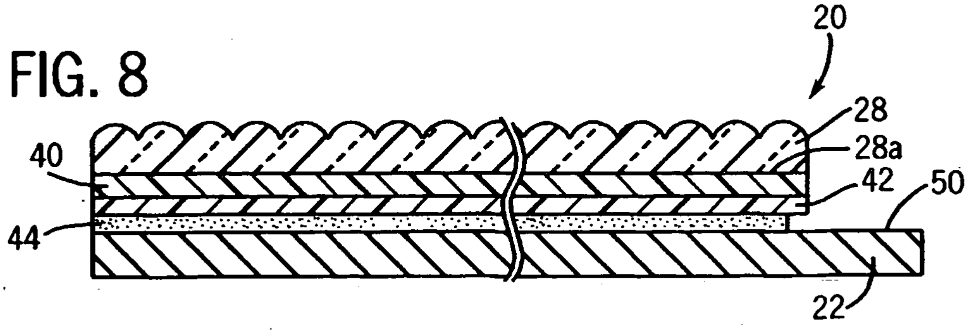
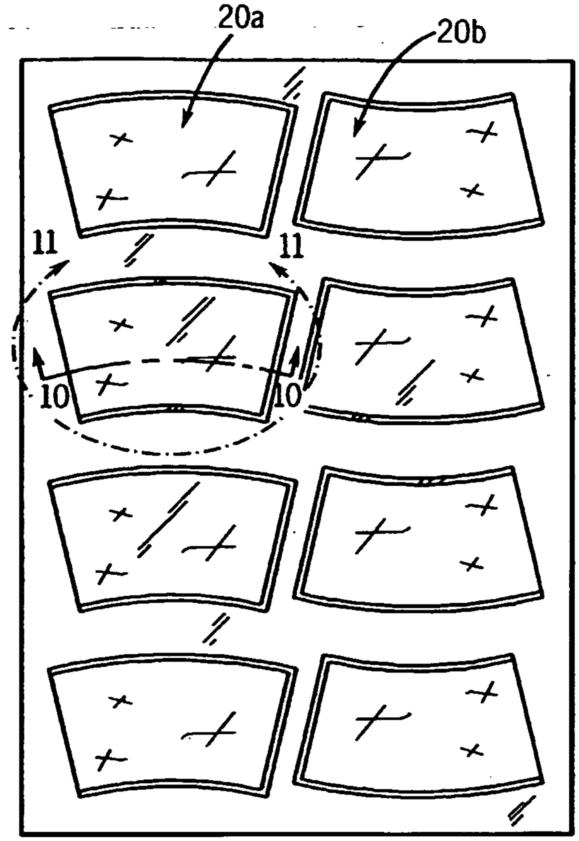


FIG.9



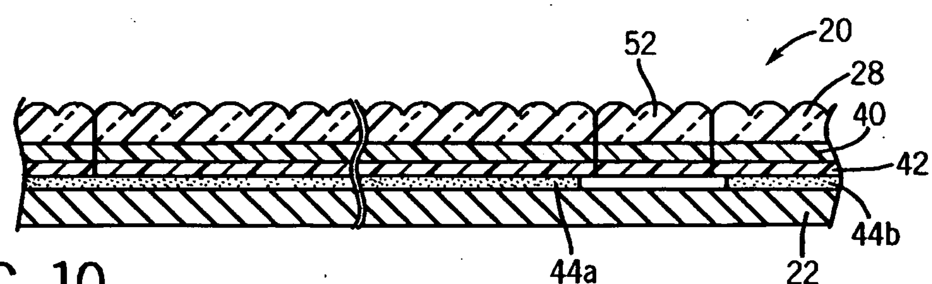


FIG. 10

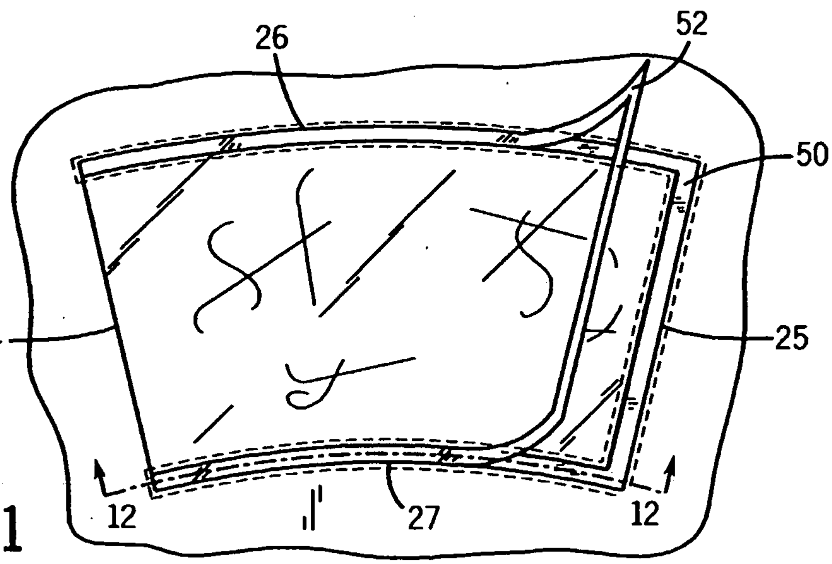


FIG. 11

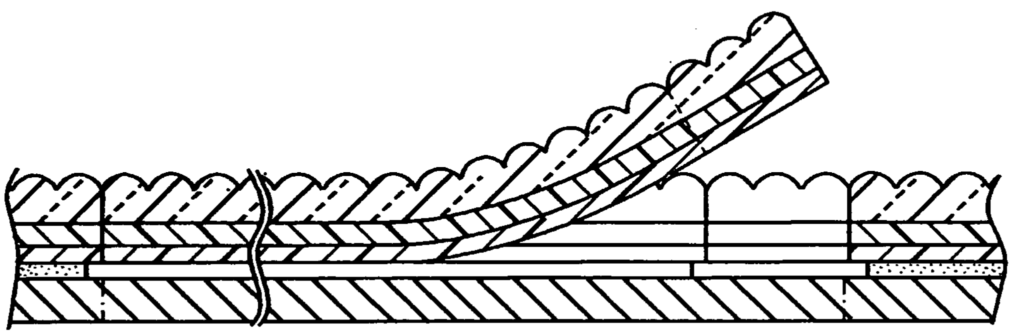


FIG. 12

FIG. 15

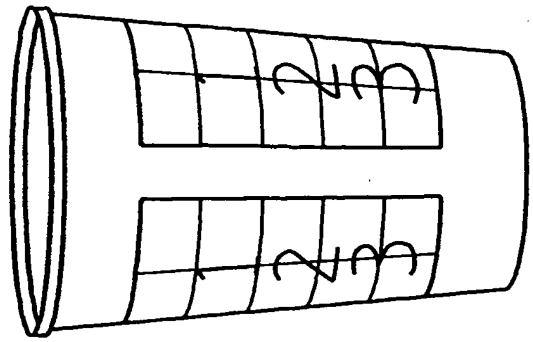


FIG. 14

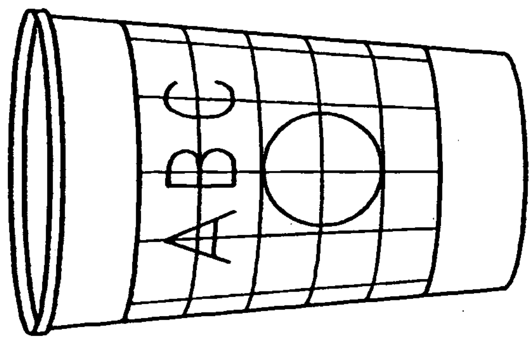


FIG. 13

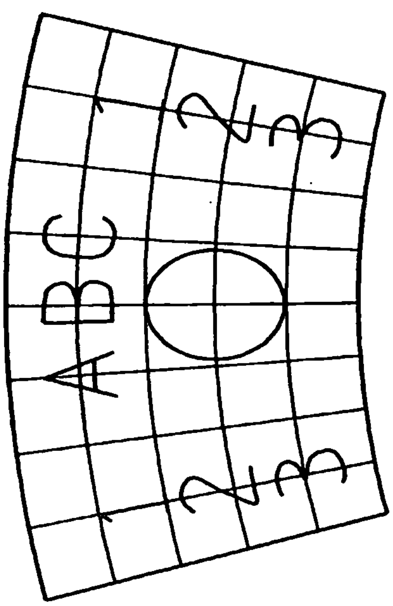


FIG. 18

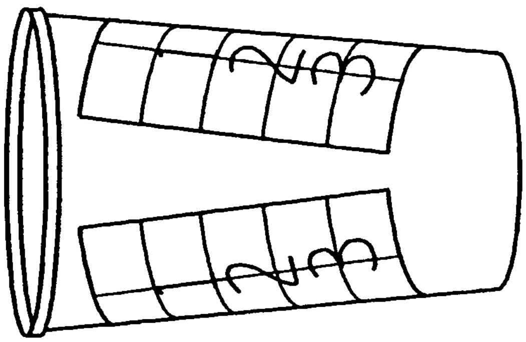


FIG. 17

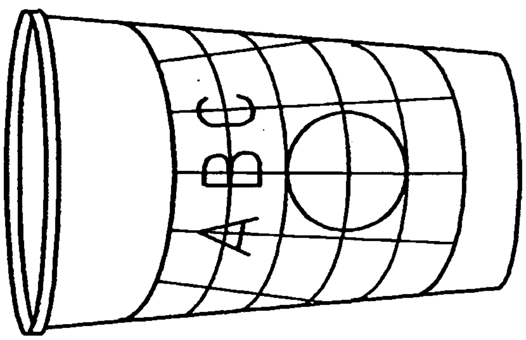


FIG. 16